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ST. LOUIS

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A LAKE AND
GULF PORT

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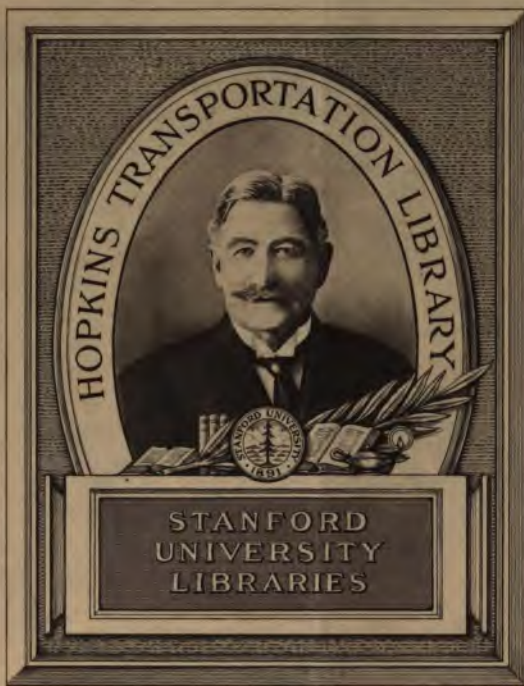
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A Deep Water-way
Joining the Lake and Gulf
Commerce

JAMES A. SEDDON, C. E.

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GIFT OF

Dr. Charles David Marx

ST. LOUIS

A Lake and Gulf Port

A Deep Water-way Joining
the Lake and Gulf
Commerce



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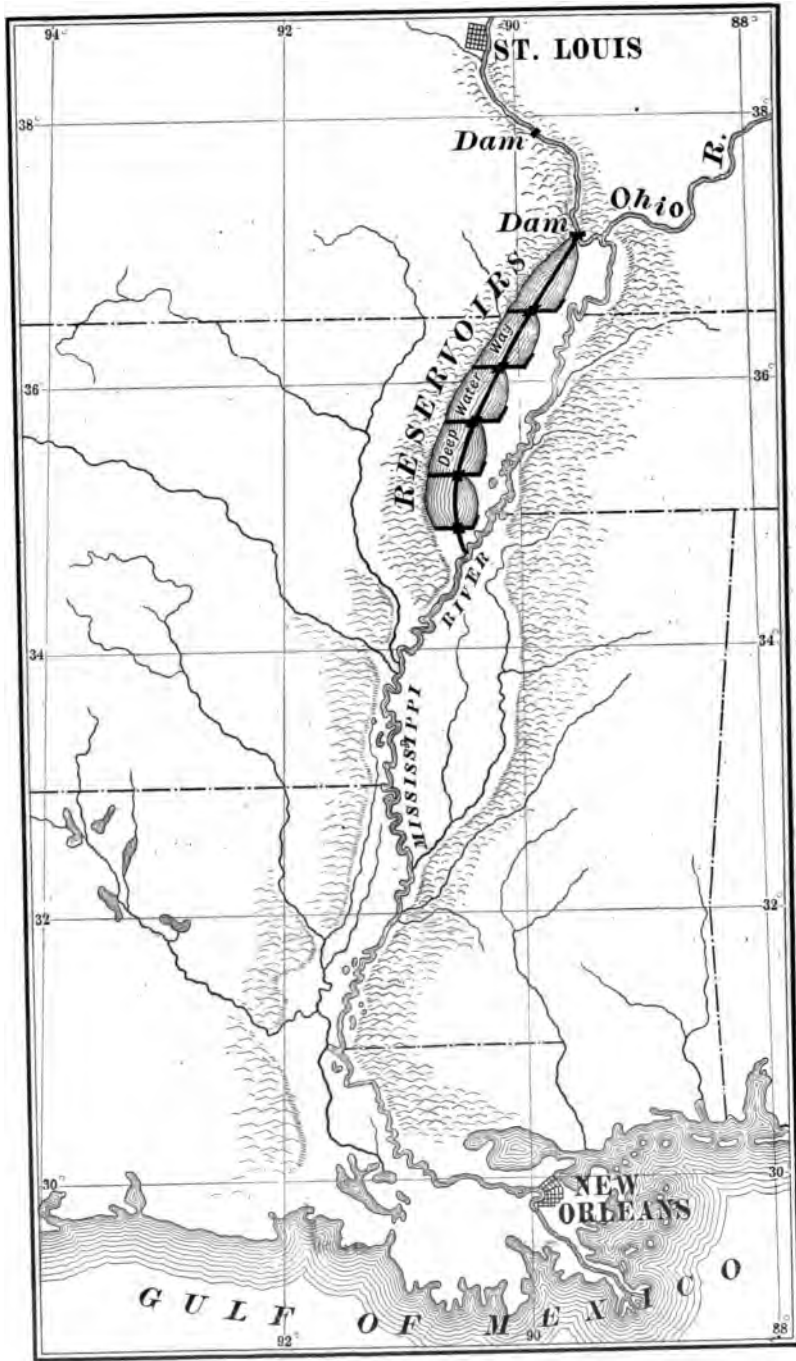
PREFACE

From early in the river work until his investigations were stopped in 1899, the writer was engaged in a systematic study of the Mississippi and its tributaries. Leaving the work with a knowledge that great improvements could be made in the rivers, while the appropriations were being spent on fruitless projects, the writer first put his conclusions in the form of technical papers: and these conclusions have not been questioned. But there is no reform in a public work until the people demand it.

That the people may understand this subject, it is here put before them as plainly as possible. There are large interests in a deep water way from the lakes to the gulf, but they have not been considered. The man who raises a crop knows how far he is from a port, for that determines its value. The products of the forest, the mine and the quarry, where out of reach, are like sand in the desert of Sahara. The whole interior is interested in getting a world's market to its doors, not simply in getting appropriations for the rivers.

JAMES A. SEDDON.

ST. LOUIS A GULF PORT.



ST. LOUIS A GULF PORT

A quarter of a century has passed since Eads built the jetties at the mouth of the Mississippi, and doubled the draught of boats that entered the river. This work made New Orleans, a hundred miles up the Mississippi, a gulf port, and now that city handles nearly a tenth of the export business of the country.

In the case of the jetties Eads was given a contract to produce results. Had the same policy been followed in works on the Mississippi, St. Louis today might have been a gulf port also.

A reservoir system below the Ohio, with locks and dams in the upper river, would have made deep channels in the Mississippi. And connecting these channels with a section of ship canal through the reservoirs would have opened a deep water route from St. Louis to the Gulf.

Above the Ohio locks and dams could be put in the Mississippi. They are in use in many rivers to deepen the navigation. Channels could be easily dredged through the chain of lakes in the back lands that form the reservoir system. The reservoirs would be emptied on the low waters of the river at the foot of the chain of lakes. There they would about triple the low water flow of the Mississippi, and maintain at all seasons a deep channel down to the Gulf. The reservoirs, also, would draw off the excess of flood waters at the junction of the Mississippi and Ohio rivers. In place of flooding the valley below, the overflow would be turned into the head of the chain of lakes and held there for the low waters. The reservoirs would have the double service of protecting the valley from overflow, and improving the river.

In the valley below the Ohio the back lands in general are more than twenty feet below the level of the ground near the river. The reservoirs would be made by building embankments from the western highlands across the low back lands. They would form a chain of lakes rising in steps from lake to lake up to the head of the valley, and altogether nearly two hundred miles long and twenty wide.

Such a system of reservoirs would draw down the extreme flood of the lower Mississippi to the level of a bank-full river, giving the valley a certain flood protection. Emptying the reservoirs on the low waters of the river would add about fifteen feet to its

navigable depth. In place of eight-foot depths at low water, gulf boats drawing twenty feet could come up the river.

Locks would be put in with the reservoir embankments for boats to pass from lake to lake, and dredges set to work cutting the deep channels through them. In place of the fleet of dredges now used to cut low water channels in the Mississippi that are obliterated in the next high water, the dredges in the lakes would cut, once for all, a deep channel that would not fill up in a century.

Above the Ohio the locks and dams in the Mississippi would be bold works. They would call for new types of construction. The site for a dam would be taken where rock could be gotten cheaply, and in large quantities it would be quarried and dumped across the river. In this the river would be trusted to sink the foundations of the dam, just as it sinks rock dykes in the depths of its light alluvium.

Two of these dams would be needed below St. Louis. In this division of the Mississippi nearly twelve million dollars have been spent on the Government project. It is estimated that about twenty millions will complete the work, giving as assumed eight-foot depth, and the interest on a second twenty million will maintain it. The locks and dams would cost little if any more than the Government project, and they would give three times its depth in the river.

Below the Ohio altogether about eighty million dollars have been spent on the Mississippi, and the levee system is about all there is to show for this expenditure.

The levees are earth embankments built along the river front to shut out the overflow. In each of the great basins of the valley the flood waters poured over the high grounds near the river into the back lands, along nearly two hundred miles of river front. For months at a time the back lands were a sea of flood waters thirty miles wide; and without some flood protection they were uninhabitable.

With the building up of the levee system, large areas of great fertility in the back lands were reclaimed and cultivated. But shutting out the overflow altogether has raised the floods in the river to levels that menace the whole valley. Farms, also, outside the levee protection, all down the valley are injured or ruined by this rise in the high waters.

The levee is like Col. Sellers' famous eye-water,—“The more they take it the more they have to take it.” The system began down in the lower river, and as it was carried up the valley it raised the flood levels in something like a geometric ratio. With each extension up stream the floods burst through the embankments below, and the levels had to be raised and strengthened in increas-

ing proportions. In the completed levee system the extreme flood stands at a general level of ten feet above the banks of the river, and thirty feet above the back lands. When the levee breaks now, the inrush of the great river over a cultivated valley is a serious calamity.

The embankment itself may be made safe enough, but in places the ground on which it is built is almost floated. When the water falls the bottom strata run out, and wide areas sink into the river. The flood water oozes up through the soil back of the levee and, with little warning, bursts through in leaks that if not stopped will quickly engulf the embankment.

The reservoirs would have cost less than the levee system. They would protect the bottom lands by drawing the flood down; not as it is, pent up between levees, with the resulting risks and damages. Every dollar of this damage is a needless destruction of private property without compensation; while not a dollar of property, that was not paid for, would have been taken in the reservoir system.

But the reservoir sites in the back lands are now protected by levees. Swamps there have been turned into farms, and the cost of the system put out of reach of the river appropriations. With railroads crossing these sites and towns building up in them, the final cost of the reservoirs cannot be estimated. But the reservoir system offers the only means in sight of making a great waterway up to the Ohio, and it offers the valley a safe and just flood protection, while in the levee system there is neither.

The area covered by the reservoirs would be taken for a thousand years. The reservoirs draw off and settle once a year a fraction of the Ohio river flood water, and they would fill with sediment very slowly. But above the Ohio the bottom lands flooded by the dams would be in cultivation again in twenty years. About seventy per cent of the sediment in the total flow of the Missouri and upper Mississippi rivers would be dropped above these dams. The deposit would build up the flooded bottoms at a yearly rate of about two feet over a hundred square miles. A look into the settling basins at the St. Louis water works will give an idea of this filling.

The sediment would drop over the bottom lands and on the sides of the channel. As the sides filled up the flow would be concentrated into a deep channel with a grade that would again carry the sediment. The Mississippi has formed its channel through the delta in just this process. For two hundred miles above its mouth the river has built the delta out into the gulf level with its sediment. In general here the channel is a hundred feet deep. Gulf boats that can get in at the mouth come up to New Orleans without difficulty.

The only place where the Mississippi has formed a bar by dropping its sediment, is where it meets the gulf waters. The river has a number of bars in the valley, but these are the detritus of banks torn down by the floods. In the valley the channel of the river is a succession of pools and shallows. The shallows in the valley and at the mouth are alike called bars, but they have widely different causes. At the mouth the flow can no longer carry its sediment; it is too weak. In the valley the flow is too strong; the alluvial soils cannot bear its currents, and it chokes itself up and spreads out in a shallow.

It is a costly work to remove one of these shallows in the Mississippi; and when removed it comes back in a new location. Eads concentrated the flow and doubled the depth over the bar at the mouth of the river. In the valley the only result of the effort to concentrate the flow has been to shift a few of its shallows. To concentrate the flow would take something like a cast-iron channel for the river.

The flood in the Mississippi tears down the banks, spreads the channel and chokes it up with bars and islands. It forms a rhythmic succession of pools and shallows. To take out the destructive power of the flood is what is needed to improve the river, not concentrating its flow.

Dams of a type common in rivers, are lowered during the floods. They do not overflow the bottom lands, but they would not improve the Mississippi. Above the Ohio the drop over the dam is needed to beat out in foam and eddies the destructive power of the flood. On the easy grade between the dams the river would then form a deep channel with fixed banks, just as it has done through the delta.

Below the Ohio the destructive power of the flood would be turned into the reservoirs; and turned back into the river when it was needed, to maintain a low water channel. To build dams here of the type required, in a valley fifty miles wide, would flood larger areas than the reservoirs. And to build dams in the great depths of light alluvium, against the interior flood water of half a continent in their mighty rush to the sea, is not a work in sight of the engineer today, if it ever will be. The improvement of this section of the river is the reservoir system or nothing.

The power of the Mississippi flood is about the biggest thing on the continent. Niagara is a small fraction of it. Altogether, it is almost planetary in its magnitude, a power that might hurl a ton of rock to the moon.

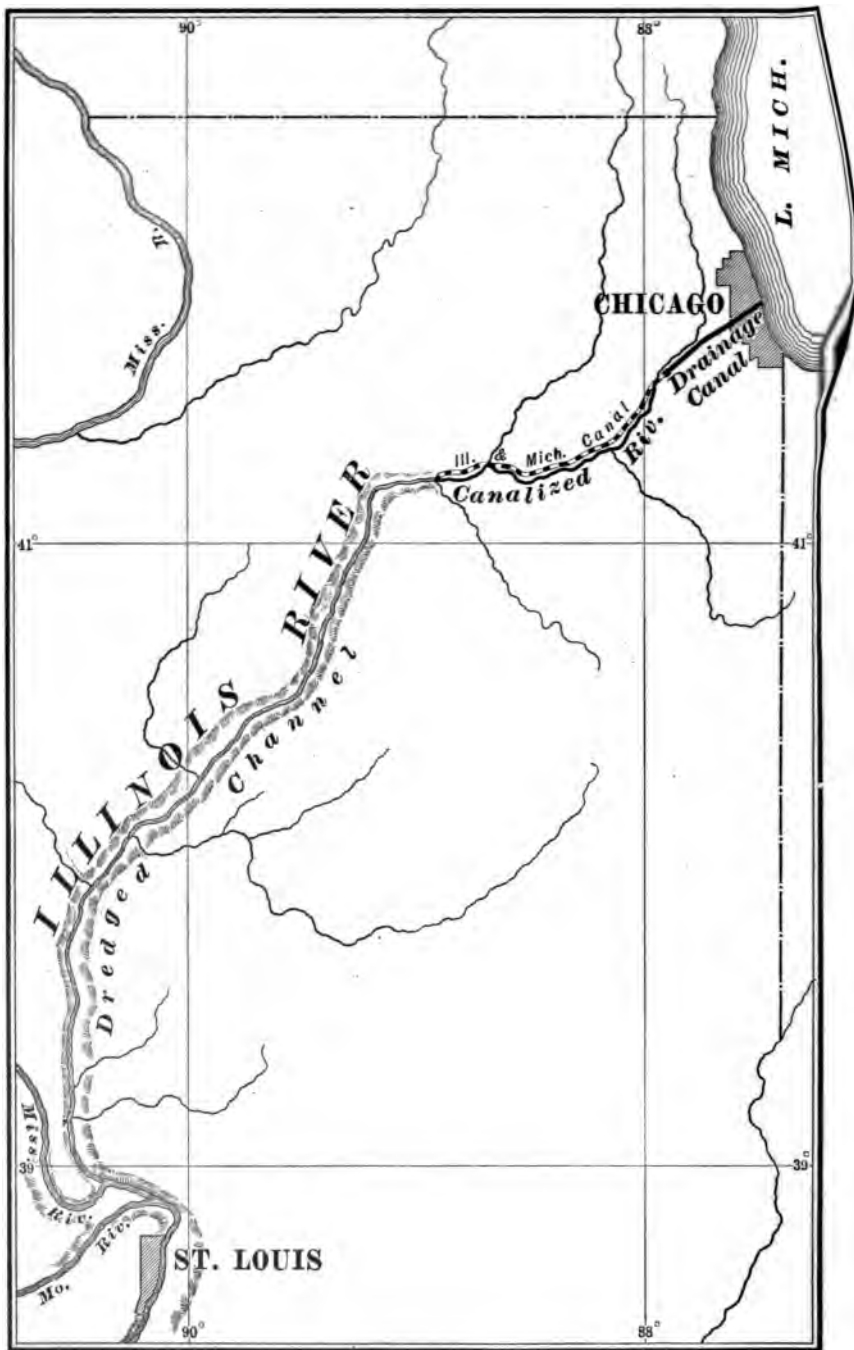
The case of the Indian who lassoed the locomotive sums up the history of work on the Mississippi. The locomotive is controlled at the throttle. When river works are directed to controlling the

power of the flood, and not to a costly futile fight with it, the Mississippi will be made a great waterway.

James J. Hill has said that the most important question before the country today is an adequate improvement of the Mississippi. The men who have built up the great railroad systems understand the value of the port better than the general public. The railroad seeks the port much as the highway comes to the railroad. The cost of moving water-borne freight between ports is about one-tenth of its cost by rail: as its cost on the railroad is about one-tenth of the cheapest team hauling. The highway thus leads to the railroad; though it also serves in local exchanges. The railroad leads to the port; though it also serves in a much larger field of exchange than the highway.

Man gathers his wealth from the storehouse of nature; the railroad and the highway are the arms that reach it. At the port it is in the world's market, and there its value is fixed. The highway may reach back fifty miles and the railway five hundred; but to open the port is to open the country. A larger service will follow, not a smaller, for the highway and the railroad.

St. Louis, a gulf port, in the center of the great valley between the Rockies and the Alleghanies,—the heart of the granary of the world,—has a future that perhaps has not yet been dreamed of.



ST. LOUIS A LAKE PORT

Up the Illinois River and through the Chicago drainage canal is the route for a deep waterway between St. Louis and the great lakes.

At one end of this route St. Louis has an Illinois River trade of about 40,000 tons a year. At the other end Chicago handles about the same amount of lake freight every day that navigation is open. A deep waterway would put St. Louis in the lake business; and the lake business made Chicago.

The lakes are land-locked waters and their commerce is largely an interior system of exchanges. They are fringed with great industries, for which they gather raw materials. Above Niagara the lakes cover a distance of about 1,000 miles on the Canadian border, with a branch to the south in Lake Michigan. To bring this branch to St. Louis would extend the reach of the lake trade and enlarge all its business.

The Illinois River is little more than a location for a deep waterway. The lower river is almost level, but it needs both a deep channel and the flow to fill it. The upper river rises in a series of rapids to the level of the prairie that borders Lake Michigan. Locks and dams are needed in the upper river to make of it a big canal.

The Chicago drainage canal cuts through the divide between Lake Michigan and the head-waters of the Illinois River. A channel nearly 30 miles long, 24 feet deep, half the cut in rock and costing \$40,000,000, brings lake navigation to the head of the valley.

The canal in the upper river would head in the drainage canal and drop in a series of levels 140 feet in 70 miles, to the lower river. In this work the channel of the upper river is taken in place of digging a canal, and practically a canal is made in it. The cost of this seventy miles of canalized river would be little more than half the cost of the drainage canal.

The flow needed in the lower Illinois for a deep waterway will come through the drainage canal. The canal will draw from the lake and send down the valley ten times the natural low water flow of the river. Dredging the deep channel through the river to take this flow would cost about six million dollars. Nearly twice this amount has been spent on the Mississippi between St. Louis and the Ohio River. The work in the lower Illinois would give double the Mississippi depth, through a longer distance, for nearly half

the money. And the Illinois channel would have no continued cost of maintenance.

Altogether the Illinois River is a good location for a deep waterway, with the drainage canal open. But without the flow of lake water from the canal, there is no way of making a deep channel through the lower river. The low water flow of the Illinois is about four per cent of the Mississippi low water, or little more than the flow of a good sized creek.

The Illinois valley was made by the lake flow before it had the St. Lawrence outlet. The lower river is more like a tidal than an inland river; its tide the occasional rise and fall of the Mississippi. The inland river is a power that has made its valley and is master of it. The tidal river is an impotent helpless thing that lies where the side drainage, that is filling up its valley, will let it. The inland river is continually cutting into its valley and throwing up the detritus on bars or shallows in its course. That spoils its navigation. The tidal river has bars also. They are brought down by creeks and tributaries and dropped into it. But a little flow goes a long way toward making good navigation in the tidal river.

The slope of the drainage canal is about double the slope of the lower Illinois. The canal flow,—24 feet deep and 160 feet wide,—will give a channel about 400 feet wide and 15 feet deep on the low slope of the river. At some time in the future the drainage canal may be enlarged and a double flow turned down the valley. This would give about the 24-foot depth in the lower Illinois, to correspond with the depth in the drainage canal, and the final needs of lake commerce.

This was Cooley's project at the inception of the Chicago drainage canal. But there is now little use for a waterway 15 feet deep. Even lake harbors with depths less than 20 feet are losing their business, and there is no prospect that a 15-foot channel would draw lake commerce to St. Louis. Until a doubled flow can be turned down the valley, the best that can be done is to raise the level at the mouth of the Illinois, and make a channel 20 feet deep through the lower river.

There is a waterway open from Lake Michigan to the Mississippi. The old Illinois and Michigan Canal crosses the Chicago divide and follows the side of the upper valley down to the head of navigation in the lower river. It is only 6 feet deep and 18 feet wide in the locks, but it was an important work in its day. The canal was opened in 1848, cost altogether \$10,000,000, and had at one time a traffic of more than a million tons a year, but now it is practically out of business.

Collecting and distributing freight is done by the railroads. They

Interests and Policies in a Lake and Gulf Water Way.

JAMES A. SEDDON, C. E.

On the waterway levels in the upper river the drainage canal flow will give about 100,000 electric horse power. The power installation would cost about \$50 a horse power. Allowing for interest, maintenance and operating expenses, the power altogether would give a net revenue of more than a million dollars a year. This value has not been taken into account in estimating the cost of a waterway. With appropriations of two or three millions a year, power interests could make a great waterway in the Illinois River; and at the same time make a good profit out of the water powers. Below the Illinois, the Government has spent about three millions a year for twenty years on the Mississippi, with practically no improvement in the river.

Between the Illinois and the Ohio rivers there would be three waterway levels in the Mississippi, with about 100,000 electric horse power to each of them. The first power would be located just above St. Louis, with a good market in sight for all of it. The three big powers in this section of the river, on a deep waterway, would be finally very valuable.

Below the Ohio there are about 25,000 square miles of rich bottom lands that require flood protection. The lands are valuable as soon as they are protected; and this is the controlling interest on the lower Mississippi. If this had been a responsible business interest, it would have made a reservoir system: giving the bottom lands a certain flood protection and the Government a great waterway. As it is, a levee system has been built that is a constant menace to life and property in the valley.

There are immediate profits in protecting bottom-lands, while the interests in a big waterway are remote. Probably the man who raises a crop and hauls it to the station knows best how far he is from a port; and is most directly interested in a waterway. The business interests buy and sell on a margin; and their first concern is to hold their trade and their profits. The river work supports a number of people, and there is a growing trade in the reclaimed bottom-lands.

The work on the lower Mississippi has served the controlling interests; though its disregard of risks and property rights cannot be justified. But it has ignored the more remote waterway interests that really warrant the government appropriations. The work has no defense; though it would now be a great hardship not to maintain the existing system of protection until it can be replaced by a better one.

Until the river is understood, any system of work can be called its improvement, though twenty years without results begins to make this claim difficult. But the Mississippi River is no longer a mystery. On a smaller scale, its phenomena are seen in streams everywhere. Like the law of gravity, its general principles have only to be stated to be immediately recognized. In this, it is seen at once why the money spent on the river has been wasted; and how it might have been spent to make a great waterway.

The history of work on the Mississippi may be made readable matter. Started in the right channels it would run itself through the press of the country. The land owners of the interior could see that they might have had a world's market at their doors if their interests in the river had been considered. With the Mississippi generally understood, Congress would not neglect the waterway.

Above the Ohio there is now little interest in the river. Here the water powers would be altogether the controlling interests. The water powers would begin to pay dividends in three or four years after the waterway was started. They would be even more immediate interests than reclaiming bottom-lands on the lower Mississippi. But the water powers are also responsible business interests that can contract to make the waterway. And in this they are a wholly new agency in the river work.

Power now may be turned into electricity, and carried fifty miles on a wire. In place of the old form of dam, with head and tail races leading to mill sites, the power installation would be put directly in the river. It would be a setting of turbines and electric generators, making altogether a great water-driven engine. It would open to the upper level, take the flow through the water wheels and pass it out at the lower level; wasting the flood excess over a spillway. With the addition of locks to pass boats between the levels, the power development is just what is needed to make a deep waterway.

It is the excess of power in a river that spreads out its flow in shallows. On the low slope of the delta the Mississippi is deep. In the valley the flood tears down the banks, spreads the channel and chokes it up with bars and islands. Between the Illinois and

Ohio rivers more than ten million dollars have been spent on the Mississippi, protecting banks and contracting shallows. The limit of this work is a few feet of additional depth at some of the worst places. It is estimated that twenty million dollars will complete the work; and about the interest on a second twenty millions will maintain it. For less money power interests can make a waterway that would pass the lake and gulf commerce through the middle Mississippi.

The existing system of river work has its origin in any aggregate of local interests that can be gotten together to ask for an appropriation. But power interests can be held to their contracts; and this is a matter for Congress to deal with directly. Its engineers can see that the Government gets what it pays for. They are not in a position to criticize work that has been assigned to them; or to recommend turning it over to new agencies.

In the middle Mississippi the deep waterway would be pioneer work. Like the Eads' jetties, it has no precedent. But through the power levels, the river will make for itself the deepest channel that its flow will keep open, as it does through the delta. And by putting the power into service, business interests can do the work at the least cost. Power interests asking Congress for contracts, are the agencies needed to improve the Mississippi,—not conventions asking for appropriations.

With a deep waterway in the Mississippi assured, work on the Illinois river would follow. Here there are some water powers in use that would have to come out. It is only with a waterway contract in view that a power is correctly located. But as yet, little of this power has been developed; and much of it will not pay for the work. Such a power alone has no value; but it will bear a part of the cost of a waterway, and leave the power interests a good profit.

The business can be handled by waterway companies. They would take the contracts, do the work, and put the powers into service. This calls for a wide range of technical and business ability, with a profit that attracts the enterprise of the country. Anything less will mar the development. But in no case should the water powers be made perpetual monopolies. The power altogether, in the big rivers, is an asset of the country in the same class as its coal fields; and put into use it goes on forever.

The members of the River and Harbor Committee doubtless understand that some radical changes in the river works are necessary. To pass the appropriation bill needs a number of votes from the interior; but if the character of the work were generally known men would not vote for it. An illustration is the Hennepin Canal

that the Government is building, at a cost of eight million dollars, about twenty miles below the old Illinois and Michigan Canal, that has lost all its business. The river traffic is going the way of the canal business. The improvements under way will have little or no use, if completed; and their final cost is so large that it is hardly considered.

But the utility of joining the lake and gulf commerce is self-evident. Profiting by a costly experience, deep channels in the rivers can be undertaken with assured results: the destructive forces put to use and made to pay a part of the cost. With business enterprise to push the work, the next twenty years should see this waterway completed.

Can go where the goods are, and deliver them where they are needed. The railroad can haul the loaded car nearly three hundred miles for the delays and costs in loading and unloading it. No road would unload its car on a canal boat, even if the boat took the freight for nothing through the hundred miles of canal. The car is run into Chicago and switched off to just the place where the freight is wanted.

The cheap transportation of bulk commodities is the business of the waterway. More than 95 per cent of the lake freight is ore, coal, grain and lumber. A waterway to take lake boats through the upper river would be more than double the cost of the old canal, but the canalized river would have some business.

On the lower Illinois there is a local traffic, and two steamboats are in the trade with St. Louis. The boat turns into a cleared space called a landing, bumps its nose up against the bank and is made fast there. The gang plank is dropped. The deck hands run up the steep incline and form into lines going and coming, singly carrying sacks upon their shoulders, or in pairs moving the bulk freight in crude hand barrows. In ten to thirty minutes the pile on the bank is taken aboard. The boat backs off into the channel and goes on to the next landing.

At the pier, the lake boat can load 5,000 tons of ore in two hours, and unload it at the docks in five hours. The lake boat can take coal from Buffalo to Duluth for the cost of taking it aboard the river steamer. With a route for lake boats open to St. Louis, the ores of Superior would be closer than Iron mountain to St. Louis furnaces. And the Illinois coal fields would be on the shores of the lake system.

To improve the lower Illinois a series of locks and dams have been put in the river. The banks are low and the flow from the drainage canal floods the bottom lands badly, with dams in the river. A deep channel would give the bottom lands a better drainage, and carry off the floods with less overflow.

Systematic dredging was about the best that could have been done in the lower Illinois. With little flow and a small slope, getting any extra depth in the river was much like keeping open a ditch. Putting in a dam would raise the level above and increase the depth for a time. This also at the time might be cheaper than digging out the channel. But the dam is a permanent injury to the valley for a temporary improvement to the river.

In the lower Illinois the Mississippi dredges are needed to cut a deep channel, with a flow of lake water that will fill this channel and maintain it. The dams are needed in the Mississippi to check the currents that tear down its banks and choke up its channel.

This instance of misplaced works is not altogether an accident. In rivers the common assumption that a flow follows lines of least resistance may be misleading. On a soil that is moved by its currents, the flow quickly chokes itself up and spreads out in a shallow. The flow makes for itself a resistance that checks its currents until the alluvial soil will bear them. Dams are needed in such a river to do the work of the shallows—the river will then improve itself.

When the power that spreads the channel is taken out of the Mississippi, its flow will make a great waterway. A lock and dam would be located just above St. Louis. It would give deep water up to the mouth of the Illinois, and hold the level needed there for a 20-foot channel through the lower river. This would bring lake commerce down to St. Louis.

Below St. Louis two dams in the Mississippi would make a deep channel down to the Ohio. But the lower Mississippi requires a different treatment. Below the Ohio the river rises and falls fifty feet between its low and high waters. Its course is a wide area of drifting sands and caving banks that shift with the changing flow continually. On the lower Mississippi the only improvement in sight lies in regulating the flow. A fixed flow works out for itself a fixed channel.

Chittenden's report in 1898 on irrigation and reservoirs treats this whole subject thoroughly. The lower Mississippi gets its flow from widely different sources with floods in different seasons. Its low water lasts but a few months in the year, and less than fifteen per cent of its bottom-lands could be made to hold the overflow of its greatest floods. To take off the flood water and return it to the low-water periods would both protect the valley and improve the river.

Such a reservoir system is now a costly work, but the lower Mississippi is a big river. Uncontrolled, the Mississippi is a merciless master of its valley forever, and trifling with it is dangerous.

This series of works, from the drainage canal down, joins the lake and gulf commerce. The gulf end is open to the Atlantic, and through the Panama canal will be open to the Pacific. On the lakes the freight movement is now more than 40,000,000 tons a year, or about four times the business of the Suez Canal that takes the bulk of the trade between Europe and Asia. This waterway has a business in sight worth considering. But it would be built for the business it makes, like the transcontinental railroad.

An interior seaboard from the arctics to the tropics, gives a short haul of all the commerce of the interior. It brings a world's market to the center of Nature's great storehouse between the

Rockies and the Alleghanies. On it ores, fuels and building materials that are now out of reach may be assembled and find a value. This waterway has the merit of being itself a home industry and of creating new ones.

St. Louis may have come to look upon its levee as a thing of little value. But the central city on a lake and gulf waterway would find its water-front choice property.



